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Study of Dural Arteriovenous Fistula Drains into Leptomeningeal Vein without Sinus Interposition

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Summary

We evaluated dural arteriovenous fistulas (DAVF) drains into leptomeningeal vein (LMV) without the venous sinus interposition. This type of DAVF contained the extra-sinusal type DAVF and the DAVF with so-called pure leptomeningeal venous drainage (PLMVD). We studied 15 patients with DAVF that flows into LMVD without passing into the sinus. The subjects were 5 patients with DAVF in the anterior cranial fossa, 2 with DAVF in the tentorium cerebelli, and 3 with DAVF in the craniocervical junction as extra-sinusal type DAVF and 3 with DAVF in the transverse sigmoid sinus and 2 with DAVF in the superior sagittal sinus as DAVF with PLMVD.

This type appears to take a very aggressive course. The arterial pressure of the shunt is directly applied to LMV, which causes bending and winding of the vein, eventually varices, inducing intracranial haemorrhage or venous ischemia in the LMV reflux area.

Emergency treatment should be performed as soon as possible. Although it is recognized that interruption of the draining vein is very effective, treatment methods such as TAE, direct surgery, and g knife treatment, or their combinations should be carefully chosen for each case.

Introduction

We evaluated dural arteriovenous fistulas (DAVF) that flows into leptomeningeal venous drainage (LMVD) without passing the venous sinus. This type is classified into two types: the extra-sinusal type1 that is present irrespective of the venous sinus, and the type with so-called pure leptomeningeal venous drainage (PLMVD) (figure 1) [2-5]. Extra-sinusal type DAVF include DAVF in the anterior cranial fossa, tentorium cerebelli, or the craniocervical junction. In DAVF with PLMVD, the shunt is present in the venous sinus wall and flows into the leptomeningeal vein without flowing into the venous sinus. This type includes DAVF in the transverse sigmoid sinus or the superior sagittal sinus.

Material and Methods

From May 1995 to December 2002, We experienced 40 cases of DAVF. We studied 15 patients with DAVF that flows into LMVD without passing into the sinus. The subjects were five patients with DAVF in the anterior cranial fossa, two with DAVF in the tentorium cerebelli, and three with DAVF in the craniocervical junction as extra-sinusal type DAVF and three

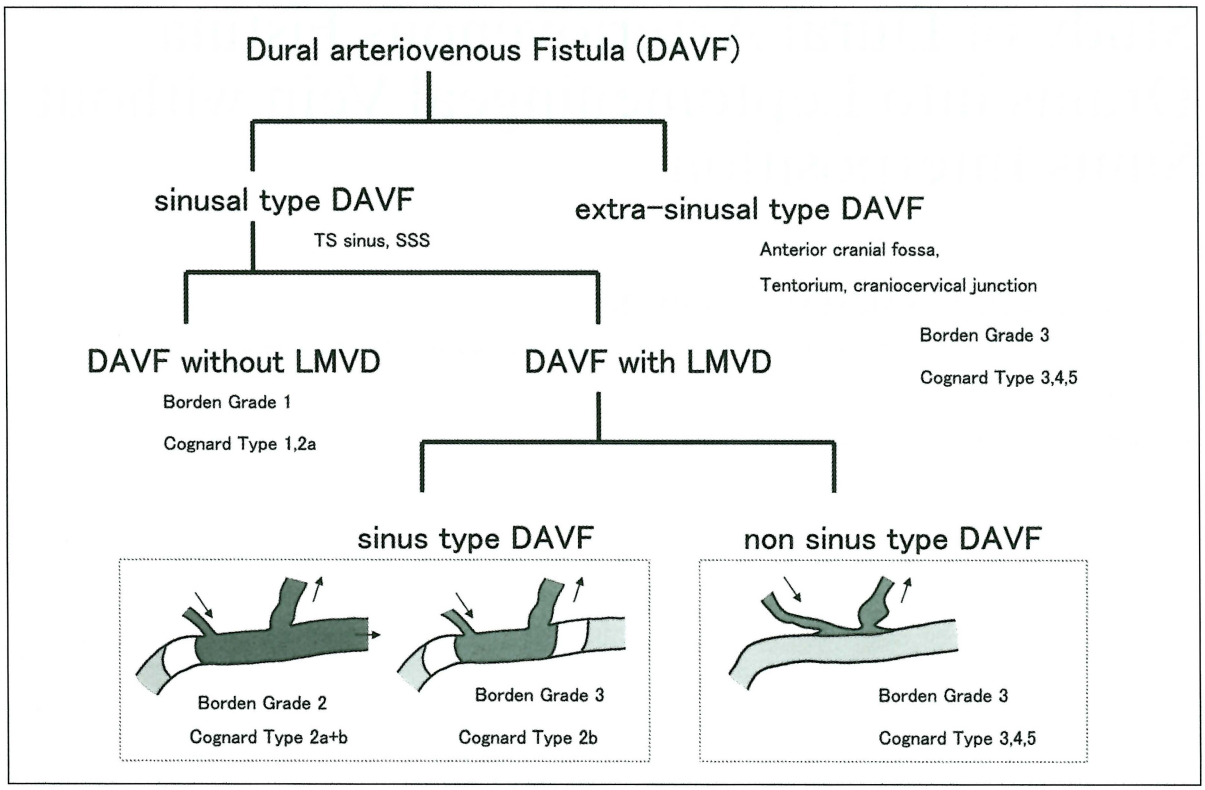

Figure 1 The conception of DAVF was illustrated. This study focused on extrasinusal DAVF and DAVF with PLMVD.

with DAVF in the transverse sigmoid sinus and two with DAVF in the superior sagittal sinus as DAVF with PLMVD (table 1).

Results

Intracranial haemorrhage was observed in three patients and venous ischemia excluding bleeding in four. As DAVF in the anterior cranial fossa and that in the craniocervical junction, the draining vein were interrupted by direct surgery. DAVF in the tentorium cerebelli was treated by transarterial embolization (TAE) alone or in combination with γ knife treatment. As DAVF in the transverse sigmoid sinus with PLMVD, DAVF was treated by TAE followed by interruption of the draining vein, and DAVF in the superior sagittal sinus by TAE. Good results were obtained in each patient. Representative cases are shown below.

Case 3: A 55-year-old male

DAVF in the anterior cranial fossa was manifested by headache. The main feeder was the right ethmoidal artery and draining vein was leptomeningeal vein draining into the basal vein, straight sinus and left transverse venous sinus.

^{123}I IMP SPECT showed venous ischemia in the left occipital lobe (figure 2). We interrupted the draining vein at the anterior cranial fossa upon using bilateral frontal craniotomy. The lesion disappeared, and venous cerebral ischemia improved.

Case 6: A 62-year-old male

DAVF in the superior sagittal sinus was manifested by tinnitus. Many feeders were present, and PLMVD was observed.

^{123}I IMP SPECT showed venous ischemia in right frontoparietal region. TAE with poly (2 hydroxyethyl methacrylate-co-methyl methacrylate) (HEMA MMA) [6] was performed, resulting in complete obliteration of the DAVF.

Case 8: A 51-year-old male

DAVF in the transverse sigmoid sinus accompanied by PLMVD was presented with

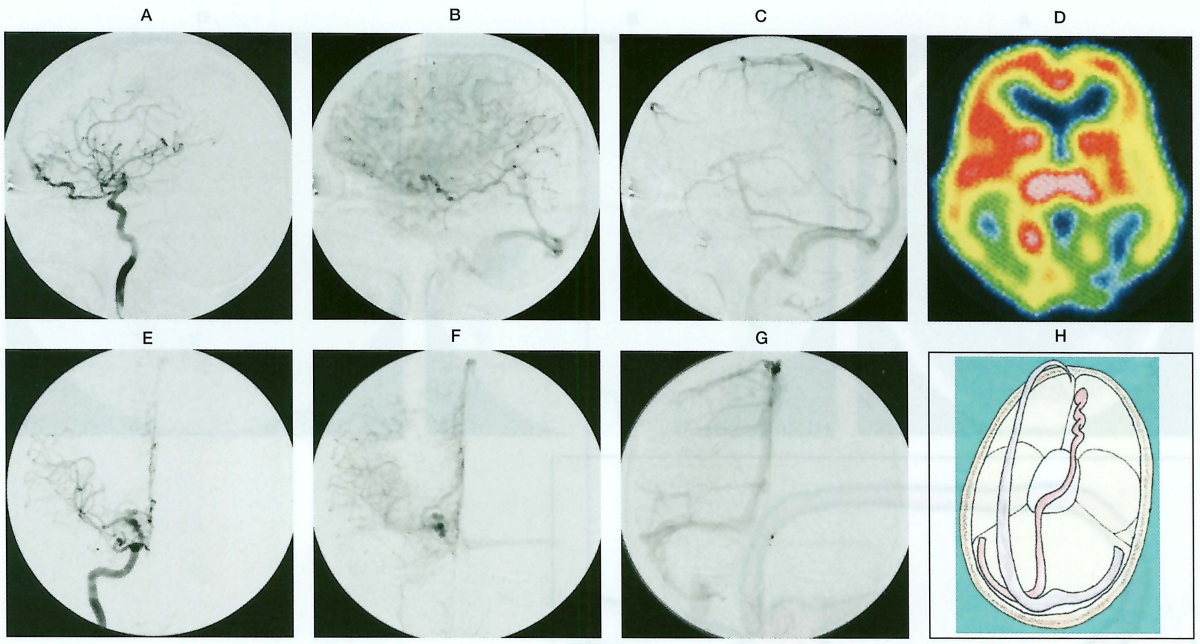

Figure 2 A-C, E-G) Right internal carotid angiograms demonstrating DAVF at the anterior cranial fossa fed by the anterior ethmoidal artery. Main drainages were olfactory vein into basal vein, straight sinus, left transverse-sigmoid sinus. D) ^{123}I-IMP SPECT showing a low perfusion area in the left occipital region. H) Scheme demonstrating the DAVF in the right anterior cranial fossa. Main drainage was olfactory vein into basal vein, straight sinus, left transverse-sigmoid sinus. Normal venous circulation of superior sagittal sinus drain into the right transverse-sigmoid sinus.

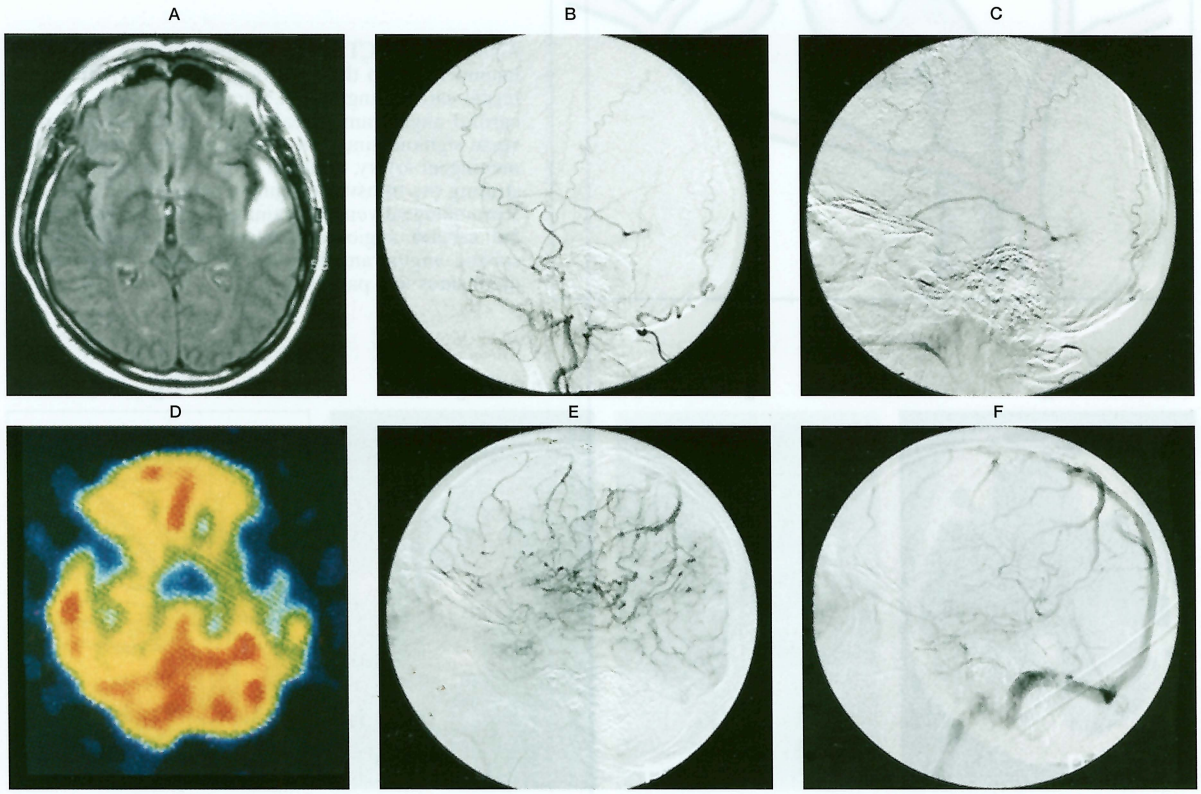

Figure 3 A) FLAIR image showed a high sinal intensity area in the left temporal lobe. B, C) Left external carotid angiograms showing the DAVF of the transverse-sigmoid sinus fed by occipital, middle meningeal arteries. The draining vein was vein of Labbé. D) ^{123}I-IMP SPECT showing a low perfusion area in the left temporal region. E,F) Left internal carotid angiograms demonstrating venous congestion in the left temporal lobe. Left transverse and sigmoid sinuses were patent at the venous phase.

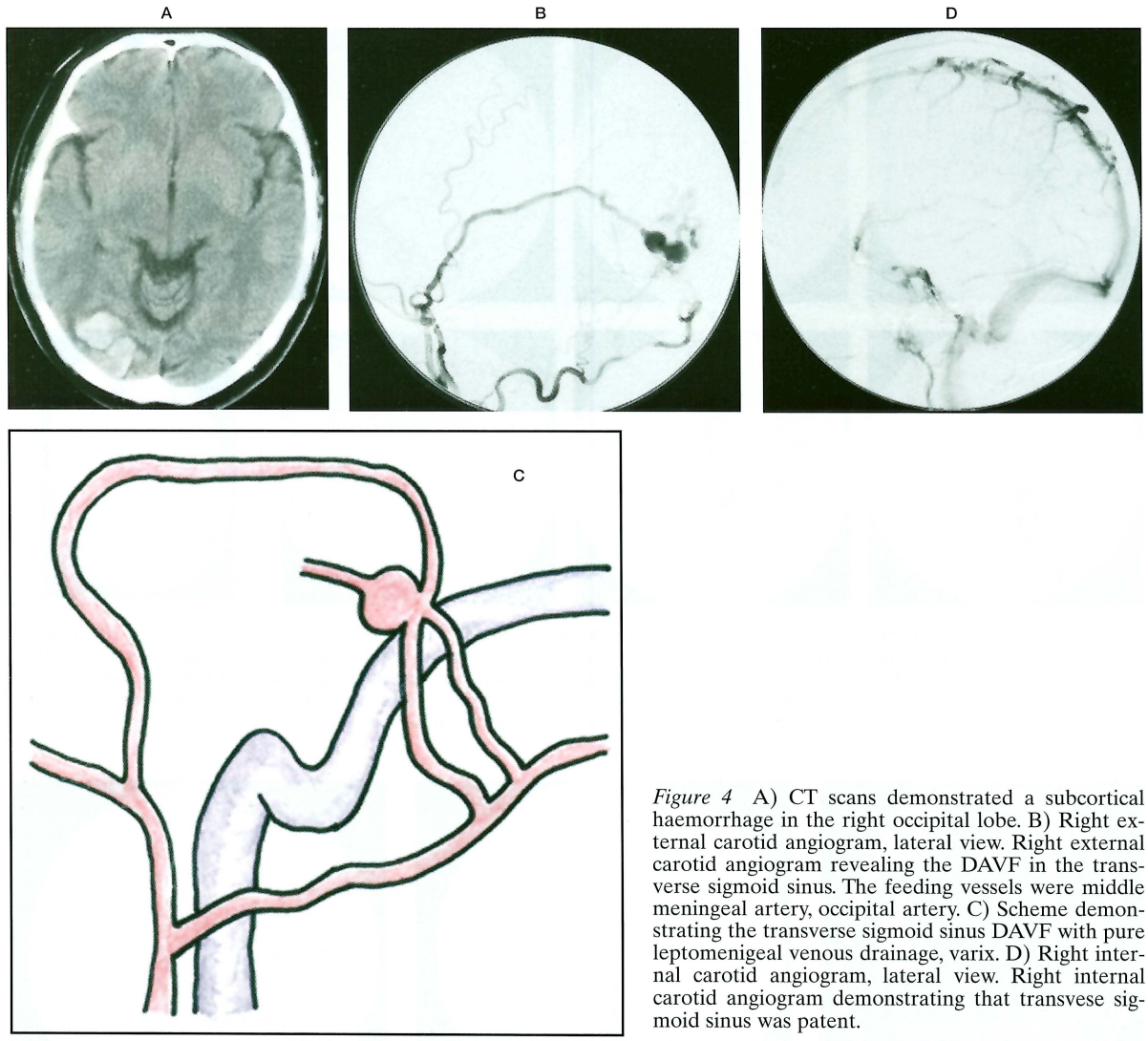

Figure 4 A) CT scans demonstrated a subcortical haemorrhage in the right occipital lobe. B) Right external carotid angiogram, lateral view. Right external carotid angiogram revealing the DAVF in the transverse sigmoid sinus. The feeding vessels were middle meningeal artery, occipital artery. C) Scheme demonstrating the transverse sigmoid sinus DAVF with pure leptomenigeal venous drainage, varix. D) Right internal carotid angiogram, lateral view. Right internal carotid angiogram demonstrating that transvese sigmoid sinus was patent.

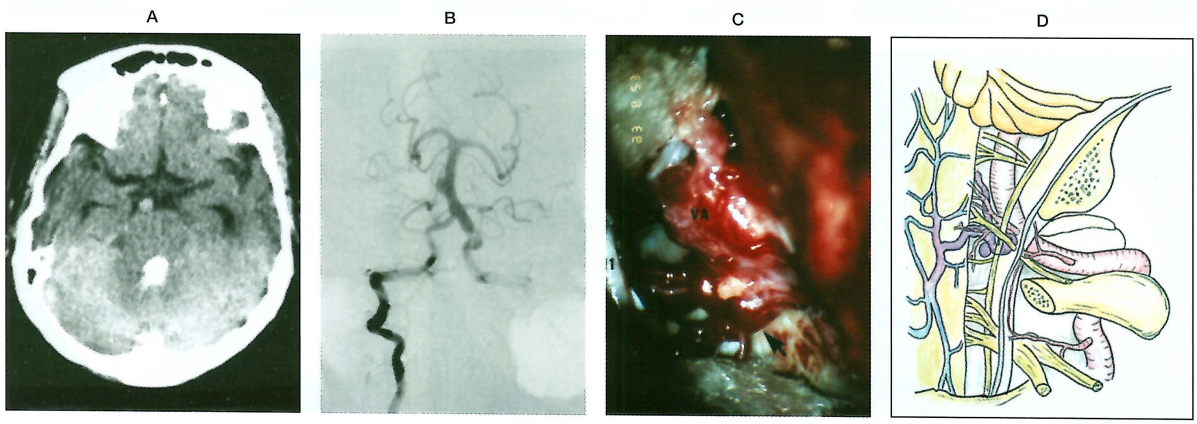

Figure 5 A) CT scan showing haemorrhage in the fourth ventricle. B) Rt vertebral angiograms showing DAVF and venous aneurysm at the craniocervical junction. An unruptured basilar midportion aneurysm was observed. C) Operative photograph demonstrated CCJ-DAVF with venous aneurysm. D) Scheme of CCJ-DAVF.Feeding vessels were C1 and C2 radicular artery. Draining vessels were posterior medullary vein with venous aneurysm and anterior medullary vein.

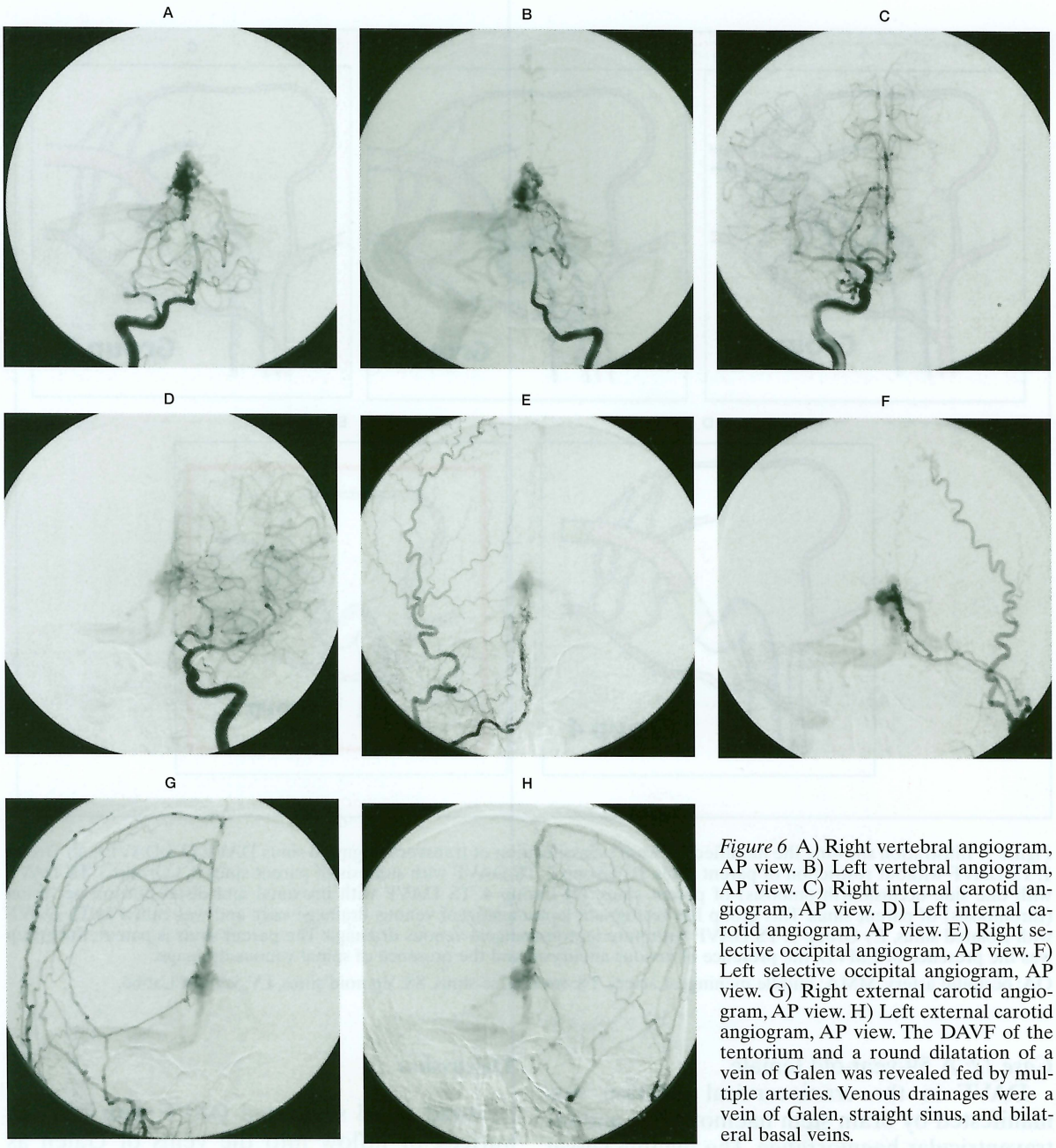

Figure 6 A) Right vertebral angiogram, AP view. B) Left vertebral angiogram, AP view. C) Right internal carotid angiogram, AP view. D) Left internal carotid angiogram, AP view. E) Right selective occipital angiogram, AP view. F) Left selective occipital angiogram, AP view. G) Right external carotid angiogram, AP view. H) Left external carotid angiogram, AP view. The DAVF of the tentorium and a round dilatation of a vein of Galen was revealed fed by multiple arteries. Venous drainages were a vein of Galen, straight sinus, and bilateral basal veins.

generalized convulsion. Brain edema associated with venous ischemia was observed in the left temporal lobe. The feeders were middle meningeal artery and occipital artery (figure 3). After TAE, we interrupted the draining vein. The lesion disappeared, and the cerebral edema improved.

Case 10: A 55-year-old male

Left homonymous hemianopsia developed, and subcortical haemorrhage was observed in the right occipital lobe.

Angiograms showed DAVF in the transverse sigmoid sinus accompanied by PLMVD and the varix (figure 4). We embolized DAVF using TAE with GDC.

Additionary, we interrupted the draining vein of the DAVF. Angiographic cure was obtained and the postoperative course was uneventful.

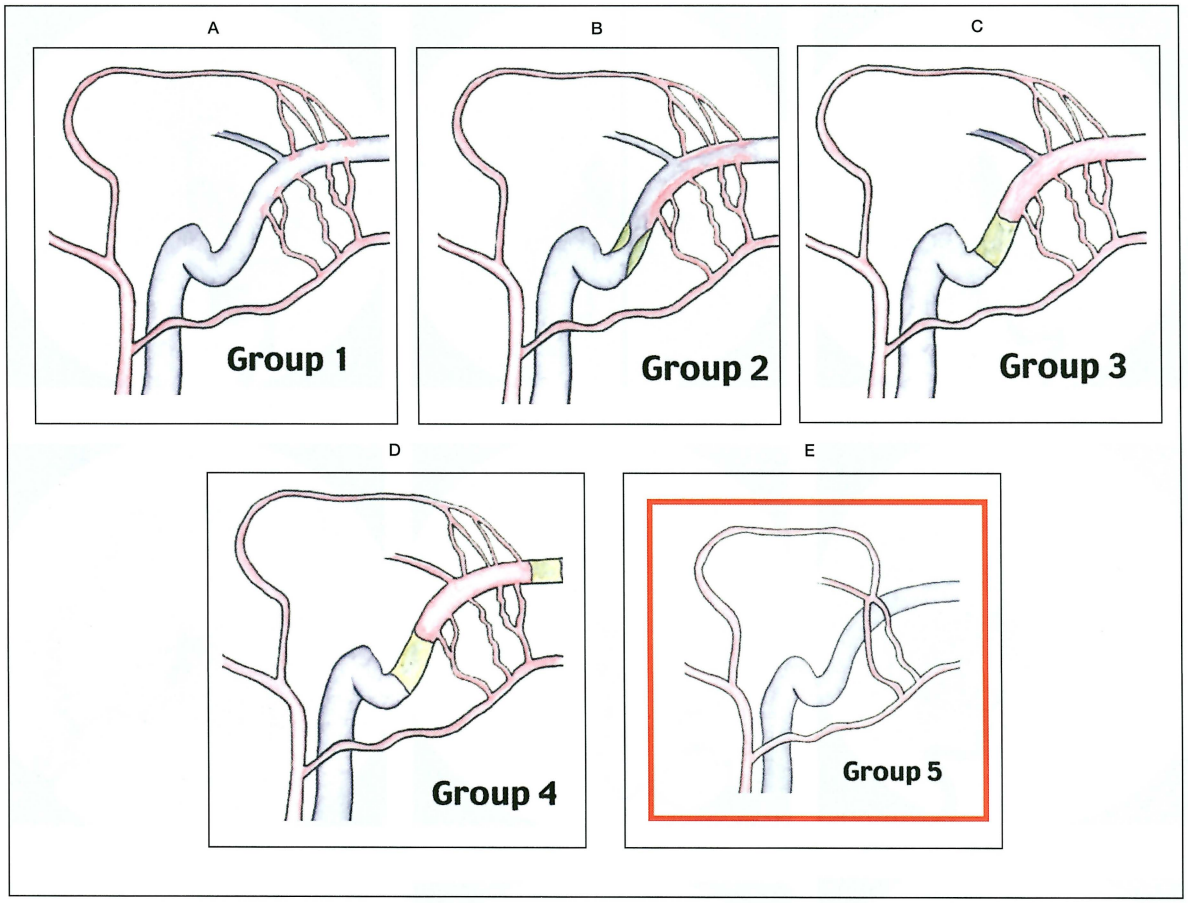

Figure 7 Illustration showing the modified Lalwani's classification of transverse-sigmoid sinus DAVF (TS DAVF). A) Group 1. TS DAVF without restriction of parent sinus. B) Group 2. TS DAVF with stenosis of parent sinus. C) Group 3. TS DAVF with one side occlusion(thrombosis) of parent sinus. D) Group 4. TS DAVF with proximal and distal portion occlusion (thrombosis) of parent sinus. This group has retrograde leptomeningeal venous drainage only and was called as TS DAVF with isolated sinus. E) Group 5. TS DAVF with pure leptomeningeal venous drainage. The parent sinus is patent. Subgroup was the presence of LMVD, the presence of venous aneurysm and the presence of spinal venous drainage.
OA: occipital artery, MMA: middle meningeal artery, TS: transverse sinus, SS: sigmoid sinus, LV: vein of Labbé.

Case 12: A 59-year-old female

DAVF in the craniocervical junction was manifested by brain stem haemorrahge and intraventricular haemorrahge. The feeding vessel was the posterior meningeal artery, and a venous aneurysm was present. The source of haemorrhage was the venous aneurysm (figure 5). After suboccipital craniotomy, we interrupted the drainage vein.

Case 15: A 37-year-old male

DAVF in the falcotentorial junction of the tentorium was manifested by headache (figure 6). After five sessions TAE, γ knife treatment was added. The lesion completely disappeared after two years.

Discussion

Awad et Al suggested DAVF with LMVD, varices, or inflow into the veins of Galen as high-risk DAVF [7]. In this study, DAVF that flows into LMVD without passing the venous sinus was evaluated. This type appears to take a very aggressive course. The arterial pressure of the shunt is directly applied to LMV, which causes bending and winding of the vein, eventually varices, inducing intracranial haemorrhage or venous ischemia in the LMV reflux area [8-12].

Emergency treatment should be performed as soon as possible. Although it is recognaized that interruption of the draining vein is very

Summary of 10 Cases of Extra-sinusal DAVF and 5 Cases of DAVF with PLMVD

Case	Age/Sex	Location	Symptom	VA	VI	Treatment
1	67/M	AC	Incidental	–	–	Interruption
2	55/M	AC	Headache	–	–	Interruption
3	55/M	AC	Headache	–	+	Interruption
4	60/M	AC	Headache	–	–	Observation
5	58/F	AC	Incidental	–	–	Observation
6	62/M	SSS	Tinnitus	–	+	TAE
7	46/M	SSS	Headache	–	–	Observation
8	51/M	TS	Convulsion	–	+	TAE + Interruption
9	47/M	TS	Headache	–	–	TAE + Interruption
10	55/M	TS	Haemorrhage	+	–	TAE + Interruption
11	72/M	CCJ	Haemorrhage	+	–	Interruption
12	59/F	CCJ	Haemorrhage	+	–	Interruption
13	62/M	CCJ	Incidental	–	–	Interruption
14	67/M	Tentorium	LOC	+	+	TAE
15	37/M	Tentorium	Headache	+	–	TAE +Rad

AC: anterior cranial fossa, SSS: superior sagittal sinus, TS: transverse sinus VA: venous aneurysm, VI: venous ischemia

effective, treatment methods such as TAE, direct surgery, and γ knife treatment, or their combinations should be carefully chosen for each case. As transverse-sigomid sinus DAVF (TS DAVF), we reported that a modified system in which TS DAVF is classified into five groups 13 by adding a group of PLMVD to Lalwani's grade 14 and three subgroup; the presence of LMVD, the presence of venous aneurysm and the presence of spinal venous drainage (figure 7).

The pathlogical state and severity of TS DAVF, necessity of treatment, and therapeutic approaches can be determined by using this classification. About Group 5 TS DAVF, draining vein is supplied directly by the arterial feeders without sinus interposition and often accompanied with venous aneurysm. On contrast, group 4 is characterized by leptomeningeal venous drainage only, due to antegrade and retorograde sinus obstruction in the transverse and sigomid sinuses [15].

As CCJ DAVF, feeding vessels were C1 and C2 radicular artery and draining vessels were posterior medullary vein or anterior medullary vein or intracranial vein. When draining vessels were posterior medullary vein or anterior medullary vein, patients presented with myelopthy. If CCJ DAVF had venous aneurysm, patients presented with subarachnoid haemorrhage.

In DAVF of the anterior cranial fossa, the incidence of the intracranial haemorrhage is high. If DAVF associated with a venous aneurysm, the risk of haemorrhage was increased. We reported a case of anterior cranial fossa DAVF with venous ischemia. But the incidence of the venous ischemia is low.

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